RES MEDICA
Journal of the Royal Medical Society
EST. 1957 Autumn 2017 VOL. 24 Issue 1
doi:10.2218/resmedica.v24i1.1470

SYSTEMATIC REVIEW

Assessment of existing layperson knowledge on the role and use of AEDs in amateur sports clubs: A systematic review of the literature

Dr. Paul Ryan Medical Student, University College Cork, 111355931@umail.ucc.ie

Dr. Éanna Falvey Senior Lecturer in Sports & Exercise Medicine, UCC, eannafalvey.sportsphysician@gmail.com

Abstract

INTRODUCTION

Sudden cardiac arrest (SCA) is a leading cause of death worldwide. Global incidence of out-of-hospital SCA ranges from 20–140 in 100 000 people, and survival ranges from 2–11%. The large increase in the distribution and availability of automated external defibrillators (AED) has led to increasing interest into layperson recognition of and response to SCA.

OBJECTIVES

The purpose of this paper is to systematically review previously conducted studies relating to knowledge, understanding and attitudes among laypersons in relation to the use of an AED in the event of an SCA. This review aims to assess and critically appraise the existing literature relating to this topic on an international level in order to identify future research directions.

METHODS

Studies were identified through an electronic database search in combination with expert recommendation. This process identified a total of 37 papers, which were screened and assessed for eligibility. A three-step selection process was applied to determine applicability to this review. A total of 10 studies were finally deemed eligible for inclusion in this qualitative synthesis.

RESULTS

Ten studies were reviewed and critiqued. Three themes emerged:

1. Knowledge and understanding of the concept of AEDs
2. Willingness to use an AED in the event of an SCA
3. Reasons for unwillingness to use an AED in the event of an SCA.

Results were compiled, summarized and discussed.

CONCLUSION

There is a paucity of literature relating to layperson understanding of AED function and use. The evidence suggests that only a minority of laypersons would be confident or willing to use an AED in the event of a nearby SCA. The extent to which an educational intervention could impact upon layperson understanding and confidence in the use of an AED is poorly understood at present.

Keywords: AED; layperson; public; understanding; attitudes; knowledge

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INTRODUCTION

Sudden cardiac arrest (SCA) is a condition in which the heart suddenly and unexpectedly stops beating. SCA usually causes death if not treated within minutes.[1] SCA represents a very prominent public health threat. Using conservative estimates, cardiac arrest is the third leading cause of death in the United States, after cancer and heart disease.[2] Global incidence of out-of-hospital SCA ranges from 20–140 in 100 000 people, and national survival rates range from 2–11%.3 There is a large variation in the reported incidences and outcomes from SCA.[4,5] A systematic review by Berdowski et al. in 2010 of global incidence and outcomes of out-of-hospital cardiac arrest identified 67 studies, and found there was more than a 10-fold variation in incidences and outcomes of out-of hospital cardiac arrest, with an average survival to discharge of 7%.[3]

It is estimated that 60 000 out-of-hospital cardiac arrests occur in the UK each year.[6] Approximately 80% of out-of-hospital cardiac arrests occur at home and 20% in public places. In England in 2013, the Emergency Medical Services attempted to resuscitate approximately 28 000 cases of out-of-hospital cardiac arrest.[7] Of this number, the average overall survival to hospital discharge was 8.6%.[7] This figure stands at 6.4% in Ireland.[8] These rates are significantly lower than those reported for populations in other developed areas: Norway 25%,[9] Seattle 20%,[10] and North Holland 21%.[11] However, these figures must be interpreted with caution due to variations in the way they are calculated and presented.

It is clear that sudden cardiac arrest is a significant cause of mortality and that there is clear potential for improvement in survival rates. Countries that have the highest rates of survival from out-of-hospital cardiac arrest are those that have strengthened all links in the "chain of survival".

The "chain of survival" in a sudden cardiac arrest

The "chain of survival" concept has evolved through several decades of research into SCA.[12] Survival from SCA is more likely if a particular sequence of events occur as rapidly as possible. The five links in the adult chain of survival, as outlined by the American Heart Association,[12,13] are outlined in **Figure 1**. Critically, laypersons form the first three links of the chain.

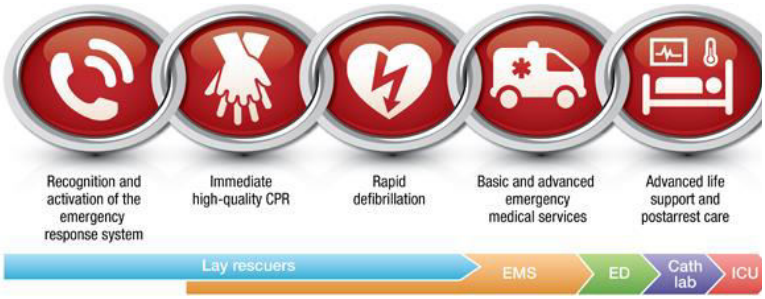

Figure 1.Each interdependent link in the chain is essential for a good outcome following an SCA.

Role of the layperson and AEDs

AEDs have become increasingly available in public places around the world in recent years, allowing bystanders to defibrillate with minimal delay if necessary. Whether or not an individual survives depends largely upon the immediate intervention of bystanders. There is a significant body of evidence showing that early defibrillation for SCA improves the chances of successful resuscitation and survival.[12,14–17] The chance of survival from an out-of-hospital cardiac

Figures from Mater Misericordiae University Hospital Dublin found that in the vicinity of an AED, 54% of victims survived to hospital discharge, compared to 1.6% in areas where no AED was available.[19] Public access defibrillation is a proven highly effective strategy for victims of SCA who arrest in public places where AEDs are installed.[20] Laypersons form key links in the chain of survival,[12] and weakness in any link of the chain lessens the chance of survival and condemns resuscitation efforts to poor outcomes. Therefore, the understanding of layperson attitudes toward using AEDs is critically important.

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Objectives

The objective of this paper is to systematically review major scientific databases to assess the extent to which existing research has investigated the understanding and attitudes of laypersons in relation to the purpose and use of AEDs. The specific goals of this systematic literature review are as follows:

1. To comprehensively search, analyse and appraise the existing evidence in relation to layperson knowledge and understanding of AEDs

2. To synthesize the evidence into themes pertaining to this review

3. To draw specific, targeted, relevant conclusions through assessment and appraisal of the evidence.

This review will allow newly collected data to be compared with existing studies, and will inform future research to assess the understanding of and attitudes towards AEDs among non-medical people.

The effectiveness and safety of AEDs in cardiac arrest is already established and thus was not a subject of investigation in this report.

METHODS

An electronic database search was performed with the objective of finding all existing relevant trials and studies relating to layperson attitudes towards and understanding of AEDs. This systematic review was designed to encompass a worldwide literature search due to global variation in attitudes towards the treatment and prevention of SCA and AED use.[21–23]

Selection criteria

Selection criteria were developed as outlined:

Inclusion criteria: The following inclusion criteria were established in order to ensure only relevant papers were included in the systematic review.

- Only articles/studies that included AEDs as a primary topic of investigation were included
- Only papers focusing on the knowledge of or attitudes towards AEDs were selected for review
- Only studies that included lay-members of the public were included.
- Exclusion criteria: Studies were excluded if they were:
- Not available as a full text
- Not human studies.

Search strategy

PubMed, MEDLINE and the Cochrane Library were the primary databases used for collating literature and identifying relevant studies, as described in **Figure 2**. The initial focused search strategy aimed to identify and critically reflect on key papers, and acknowledge the work of recognized experts in the field of Emergency Medicine and Resuscitation. This was later expanded to also include ScienceDirect and Google Scholar for a broader search of existing literature.

Each database was searched up until March 2015 using combinations of keywords including: AED; layperson; understanding; attitudes; knowledge; awareness; public.

These search terms were selected as the core concept under investigation in this review was layperson understanding of AED use. In order to assess the depth of understanding that members of the general public have regarding the role and use of an AED, one is also seeking to ascertain their awareness of the existence of the device, their knowledge of its function, role and purpose, and their overall attitude towards its use. It was decided that these keywords were most reflective and incorporative of the objectives of the review. In all cases, the searches of the above electronic databases were not restricted in terms of study type, year of publication or sample size. Due to the under-researched nature of the topic being discussed, these databases were searched exhaustively to find all relevant literature, both published and unpublished.

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Study selection

The search of the Cochrane Library was not restricted in terms of study type, year of publication or sample size. Inclusion of the search term "automated external defibrillator" returned only 1 result. Unfortunately when read in full this study did not address the issue of layperson attitudes or understanding of AEDs in any form. Based on the outlined criteria this study was excluded from the review.

Using filters, the search of PubMed was restricted to studies relating to human subjects and with the full text available. The search was not restricted in terms of study type or sample size/type. Search with the keywords "AED" AND "attitude" returned 114 results. The addition of the keywords "public" OR "lay" narrowed the search to 25 papers.

This subset of papers was assessed manually, using titles and abstracts as a preliminary method of inclusion/exclusion. Initially, titles were screened and assessed for relevance; irrelevant studies were excluded, leaving 16 studies. The abstracts of each paper were then screened and, again, studies that did not satisfy the inclusion criteria or with confounding factors and/or obviously flawed methodology were excluded. The main reason for exclusion was that studies did not include laypersons as a study group or did not include attitudes or knowledge of AEDs as a topic of study or discussion. Eight studies were left after the second stage. In the third stage, the full text of the remaining studies was read. Those studies deemed relevant to the objectives of this paper were retained, while those with clear bias, the presence of confounding factors or unsupported conclusions were excluded. At the end of this selection process five papers were selected for inclusion. Identical search criteria as described for PubMed were applied to a search of the MEDLINE database. Twenty search results were returned. Duplicates of studies screened on PubMed were removed and the same selection process was used to assess studies for relevance. One further paper was selected for inclusion in the review.

References from retrieved papers were checked in order to identify additional reports. This process yielded three extra studies. These papers were traced by using their titles in a Google Scholar search. A medical official with extensive background in SCA emergency response and research recommended one further article for consideration.[24] The flowchart of the study selection results is presented below in **Figure 2**.

Data Extraction

Studies that met the inclusion criteria and were deemed relevant were selected, and the overall individual validity of this evidence was thoroughly assessed using the EBL Critical Appraisal Checklist.[25]

The following data was extracted from each study:

1. First author & year of publication
2. Study design
3. Study population
4. Sample size
5. Methods
6. Analysis tools
7. Results
8. Conclusions.

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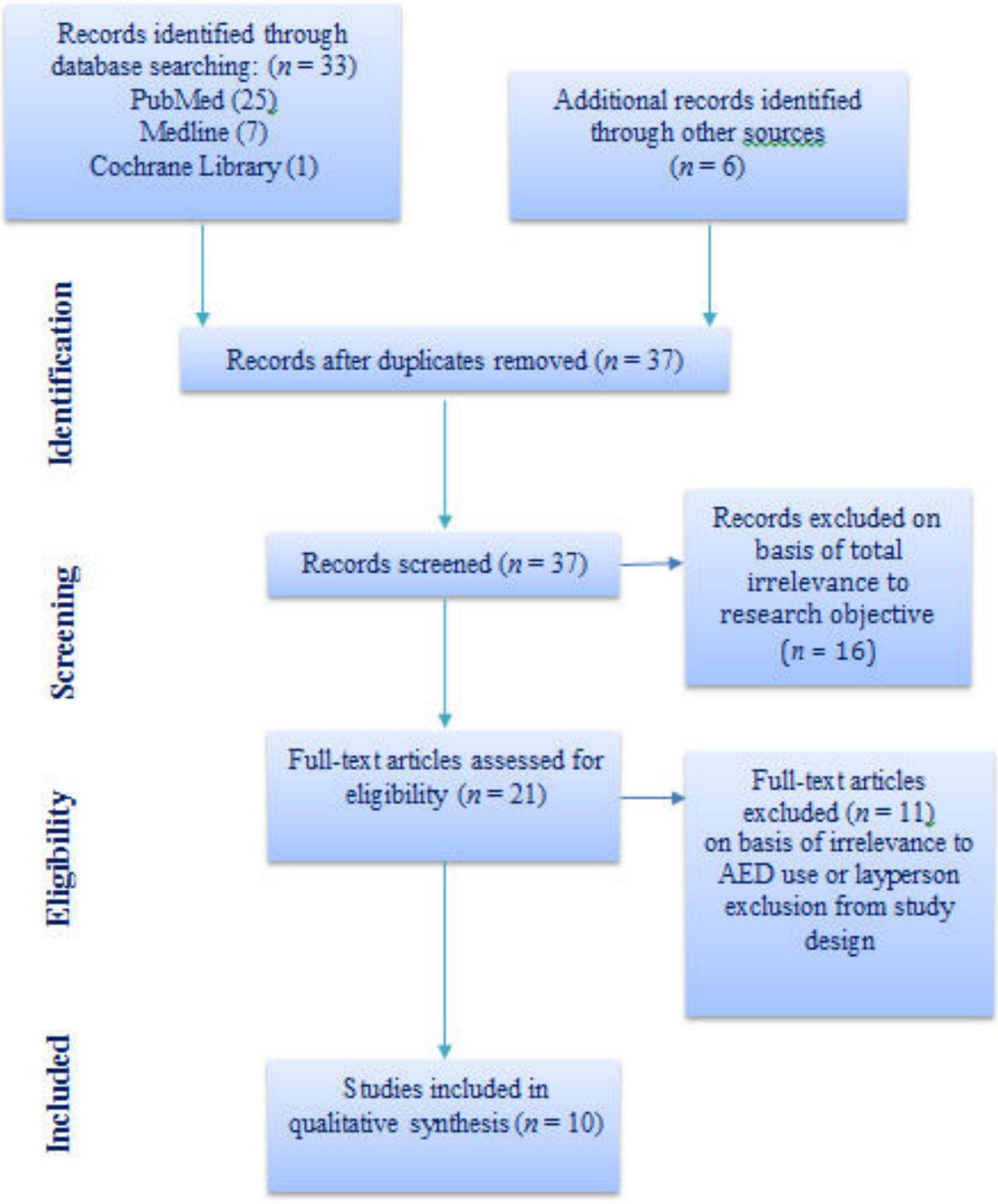

Figure 2. Prisma flow chart of searching process

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Table 1. Summary of selected studies

Study	Location	Study Design	Sample size	Outcomes Measured	Key Findings	Strengths/ Limitations
Taniguchi et al., (2008) [27]	Japan	Quantitative cross-sectional survey (paper questionnaire)	3328 (including high school students, teachers, emergency medical technicians (EMTs), medical nurses, and medical students)	• Knowledge of AEDs • Willingness to apply and operate an AED • Reasons for unwillingness to operate AEDs.	All EMTs, 86% of nurses, and 90% of medical students knew how to use AEDs, while only 15% of high school students and 44% of teachers had such knowledge. All EMTs, 78% of nurses, and 94% of medical students reported they would "definitely" use the AED, but only 12% of high school students and 35% of teachers gave this reply. The reasons for unwillingness to operate AEDs among both laypeople and health care providers were poor awareness of what AED is and/or how to use an AED. However, many non-medical people in Japan would be willing to operate AEDs if they had better understanding of the equipment and its operation.	**Strengths**: • Efforts made to reduce potential bias. • Large sample size. • Well-defined criteria for inclusion in study group/search protocols. • Results were significant. **Limitations**: Surveys can only measure what people say they will do, not what they actually do. There may also be a selection bias present in this particular survey. The study included high-school students and high-school teachers as layperson representatives, although they were chosen randomly. Subgroups are not necessarily representative for the entire population they originate from.
Taniguchi et al., 2014 [28]	Japan	Quantitative cross-sectional survey (paper questionnaire)	2527 (high school students, teachers, medical nurses, and medical students)	• Knowledge of AEDs • Willingness to apply and operate an AED • Reasons for unwillingness to operate AEDs • Respondent's age and any	47% of high school students, 89% of teachers, 93% of nurses, and all medical students responded that they were familiar with the concept and use of AEDs. 73% of high school students, 87% of teachers, 98% of nurses, and all medical students surveyed claimed they would definitely use AEDs if required. Reasons for not operating an AED were similar to the 2006 study. 85% of respondents not willing to operate an AED cited lack of knowledge regarding the	**Strengths**: • Large sample size. • Participants were chosen randomly in attempt to remove selection bias. • Well defined criteria for inclusion in study group/search protocols • Results were significant. **Limitations**: Survey can only measure what people say they will do, not what they actually do. There may also be a selection bias present. In addition, the study respondents were only high

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				previous training on the use of an AED.	concept of AEDs and how to use them as the main reason.	school students and high-school teachers as layperson representation. Further investigations are needed about non-medical people in Japan.
Bogle et al., 2013 [26]	USA	Quantitative cross-sectional study (online survey)	237 (undergraduate and graduate students at a mid-sized, private university)	• Training of respondens General knowledge of AEDs and CPR, • Comfort with AED/CPR use with and without 911 assistance • Knowledge of AED location.	98.5% could identify CPR and 88.4% an AED from images. Only 46.1% and 18.4% respectively, could indicate the basic mechanism of CPR and AEDs. 28.1% were comfortable using AED without assistance, compared with 65.5% when offered assistance. Of those uncomfortable, 87.7% indicated that they were "afraid of doing something wrong". 17.7% respondents knew that a student center had an AED; only 2% could recall its precise location.	**Strengths**: • Validated questionnaire • Efforts made to reduce selection bias. • No help offered to participants. **Limitations**: Small sample size. Survey can only measure what people say they'll do not what they actually do. Selection bias: people with medical background seem more likely to complete a survey involving a medical topic, thus data may overestimate the likelihood of AED use.
Schober et al., 2011 [29]	Amsterdam, Netherlands	Quantitative cross-sectional survey (standardized interview)	1018 (Bystanders at Central Railway Station of Amsterdam. Included people from 38 nations)	Knowledge and attitudes toward AEDs among the public.	This study revealed a considerable lack of knowledge among the public relating to AED use. Less than half of participants (47%) would be willing to use an AED, and more than half (53%) were unable to recognize an AED. Overall, only a minority of individuals has sufficient knowledge and would be willing to use an AED. Conclusion: Extensive public education is needed before AEDs can be expected to maximize their public health influence.	**Strengths**: Cluster sampling approach for selecting participants was unbiased, assigning equal chances of being selected to each individual. A zone of 3 m around two preselected AEDs was defined as the cluster. Individuals entering the zone were invited to participate in such a way that they could not recognize they would be interviewed about medicine/AEDs. **Limitations**: No generally accepted questionnaire available to test public knowledge and attitudes toward AEDs. Questionnaires were designed from scratch and piloted, thus this questionnaire was not a validated study instrument. Cannot determine whether subjects' answers actually reflect their personal opinion. The study did not count the number of individuals refusing to

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						participate. Subgroups are not necessarily representative for the entire population they originate from.
Caffrey et al., 2002 [16]	Chicago, USA	Prospective observational study	2 154 000 (estimate) (Passengers passing through terminals at O'Hare, Midway and Meigs Field airports over a 2 year period.)	Number Of SCAs in Chicago airports over 2 year period, Survival rate at 72 hours and at one year, Characteristics of rescuers.	AEDs deployed in readily accessible, well-marked public areas in Chicago airports were used effectively to assist patients with cardiac arrest. In the cases of survivors, most of the users had no duty to act and no prior training in the use of these devices. Conclusion: lack of training should not constrain attempts to use a defibrillator in emergencies.	**Strengths**: Very large sample size. Study design minimizes unbiased results. Study measures how participants actually responded and not how they would respond. Thorough follow-up of rescuers. **Limitations**: 3 of the 7 untrained rescuers who performed successful defibrillation had medical degrees. Thus, it is not known whether these results can be generalized to other public places that may be less frequented by health professionals.
Lester et al., 2000 [33]	Wales	Cohort	1600 (Two independent samples of 800 layperson CPR trainees from an original cohort of 7584 were surveyed by post 4 years after training.)	Sample 1: Use of resuscitation skills since original course. Willing to retrain? Level of confidence in CPR and AED use. Sample 2: Willingness to perform full CPR.	Only 2% of respondents had used CPR since their training, but 92% had used other aspects of their life support training. Those who had retrained were more confident than those who had not and 89% of those who had not retrained were willing to do so. More than 80% expressed willingness to perform full CPR including AED use on casualties who were unknown to them.	**Strengths**: Use of control group improves statistical validity of study. Large sample size. Cohort study design allows investigation of temporal development of the studied population. **Limitations**: Survey can only measure what people say they'll do not what they actually do. Selection bias: people with medical background seem more likely to complete a survey involving a medical topic, thus data may overestimate the likelihood of AED use.
Hubble et al., [33]	North Carolina, USA	Quantitative cross-sectional survey	683 (Sample of high-school students in North Carolina)	Willingness of respondents to perform CPR and automated external defibrillation in a cardiac arrest scenario.	86% were trained in CPR. 21% were trained in AED. Respondents indicated that they would be willing to perform: Chest compressions in 55% of cases. Mouth-to-mouth resuscitation in 43% of cases.	**Strengths**: Data is valid, significant and congruent with findings of similar studies. Validated questionnaire. Efforts made to reduce selection bias. No help offered to participants.

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					AED in 32% of cases. Conclusion: Amongst high-school students, few are willing to perform AED. Willingness to perform chest compressions and mouth-mouth resuscitation appears to depend on the circumstances.	**Limitations**: Study surveyed how participants "would" react. Actual SCA response may vary. Studied population does not particularly represent the general population. Respondents asked to assume that nobody else at the scene was willing to perform CPR or AED. This may lead more respondents to indicate that they would intervene than if they believed somebody else at the scene might be trained and willing to intervene.
Cronin et al., 2013 [31]	Cork, Ireland	Retrospective quantitative cross-sectional review survey	218 (Amateur sports clubs in Cork)	Attitudes to AED use at a general club level: including AED availability, use and practices in amateur clubs. (AED availability, purchase, time-since purchase, usage, storage, placement, number of club members trained in AED-use and maintenance)	This study represents the first study of AED practices and availability in amateur sports clubs in Europe. A large proportion (81.3%) of amateur clubs in Cork City and County own an AED. While many clubs engage in appropriate training, maintaining and storage of AEDs, many clubs do not. This represents a potential flaw in the chain of survival in the event of an SCA in sport. This study identifies several areas for improvement and to raise awareness amongst amateur sports clubs in facilitating a secure chain of survival for players in the event of an SCA. Regular retraining and training of new club members in AED use is a priority and needs to be facilitated.	**Strengths**: High response rate achieved. Large, diverse cohort of amateur sports clubs. Club committee members were targeted to participate. They represent a reliable and knowledgeable source central to club. Cork is the largest geographical county in Ireland. Most likely offers real-world reflection of emergency planning for SCA in amateur clubs across a large target area. Study examined urban and rural clubs, thus reflects practices in both populated counties as well as metropolitan cities. **Limitations**: Study limited by cross-sectional survey design. Study group of club committee members was at risk of responder bias. Study focuses on the distribution and maintenance of AEDs in sports clubs. It does not account for knowledge and attitudes of the study population who might find themselves using the AED, namely lay-members of the club.
Christ Et al., 2012 [24]	Herne, Germany	Quantitative cross-sectional survey (standardized interview)	531 (layperson visitors to the amusement swimming park "LAGO-die	Knowledge of first aid and AED use before and after a community education process.	Knowledge of first aid (59.1%) and AED use (45.2%) was poor, especially among persons younger than 17 years or older than 67 years. 398 (75%) of the interviewed visitors	**Strengths**: Selection bias was reduced, as participants were unaware that they would be partaking in a medical survey prior to commencement. Survey design was reviewed using a three-step process prior touse. Participants represented a broad age

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			Therme".)	To find out whether intensive medical education can improve the recognition of AED at public places.	recognized the installed AED, 511 (96,2%) supported the placement of AED. The placement of AED on public places in combination with an intensive medical education results in a high acceptance and recognition of AED.	range, from a broad cultural background. **Limitations**: A major flaw was that a local education program was conducted but the people who attended the program were not necessarily the same as those surveyed. Unaccounted individual variations may have had a substantial bearing on results. A sample size of 531 is too small to allow definitive conclusions. Subgroups are not necessarily representative of the entire population they originate from. Visitors to a swimming park may not necessarily represent fairly the attitudes of the German population.
Lubin et al., (2004) [30]	USA	Quantitative cross-sectional survey (paper questionnaire)	359 (shoppers in a suburban shopping mall)	Familiarity of the general public with automated external defibrillators (AEDs) and their willingness to use them.	60% were able to define "defibrillator" adequately. 71% stated they would be likely to use an AED to resuscitate a stranger. Most common concerns were fear of using the machine incorrectly (57%) and fear of legal liability (38%). Conclusion: Although a substantial number of people in this setting were willing to use an AED, education regarding legal liability and proper use of the machines increased the reported likelihood of use. Further public education may be necessary to provide optimally effective public access defibrillation programmes.	**Strengths**: 4 non-investigator physicians and 4 non-medically trained persons reviewed the survey prior to use to improve clarity. No assistance was given to participants as they completed the survey. Completed surveys into groups by age and degree of medical training, with clearly defined inclusion and exclusion criteria. **Limitations**: Survey can only measure what people say they would do, not what they actually do. Selection bias: people with medical background seem more likely to complete a survey involving a medical topic, thus data may overestimate the likelihood of AED use. Concerns over external validity in that the survey was administered in one suburban mall over a relatively limited time period. Study did not track the number of people who refused to participate in the survey. This may lead to additional bias in sampling methods.

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RESULTS

Studies from a broad range of countries were reviewed, varying in size, scope, design, variables, and methods. The topic of layperson knowledge and attitudes towards AEDs was approached by the reviewed studies in various ways and the results are summarised in **Table 1**.

There was a large variation in the range of the papers studied. The sample sizes ranged from a survey of 237 people in one study, [26] up to an observational study of greater than 2 million in another.16 Eight of the reviewed papers were standardized survey-based studies, with sample sizes from 237 people to 3328 people.[27] These studies gave direct feedback from a large number of respondents on a broad range of questions examining attitudes, perceptions, understanding, and willingness to use an AED amongst a particular population. However, several limitations inherent to a survey study design were inevitable. Sampling bias has to be considered, as those who chose to participate may have been more informed, more motivated, or more interested in AEDs. As a result, the data may overestimate the likelihood of AED use, as studies did not count the number of individuals refusing to participate.

From the participants who agreed to take part in the studies, it can be seen that the populations being studied varied significantly between papers. The vast majority of those included in the studied populations were members of the public. Participants included high-school and university students, bystanders at train stations and airports, customers in a shopping centre, and visitors at an amusement park. Notably, three of the papers reviewed[16,27,28] included trained healthcare professionals as part of the studied population, including medical students, nurses, and EMTs. This was identified as a source of potential bias. Trained healthcare workers cannot be considered laypersons in this setting, and their understanding of AEDs is unlikely to be a fair representation of the knowledge of non-medical members of the public. This may contribute to an overestimation of the baseline layperson understanding of AED use.

The broad spectrum of participants studied in various settings also represented a very broad age range, from teenagers at school to elderly laypeople in public places. This diversity of study populations and sizes may make the generalization of findings more difficult and less applicable to larger populations. However, it does provide an interesting and highly relevant body of data that can be interpreted and compared to give an indication of overall levels of awareness and understanding of AED use in a variety of different contexts, allowing a greater understanding of public shortcomings regarding knowledge and use of AEDs, and highlighting potential areas for improvement.

Since the data from certain studies was gathered from a cross-sectional sample of the public over a relatively limited time period, the results might be affected by differences in cultural, ethnical, and other social circumstances, and the findings may not be representative of attitudes and beliefs in other countries. As a result, there are concerns over external validity as the conclusions may not be universally applicable to different population subgroups. For example, in the Schober et al. study,[29] train users or visitors to the Netherlands from other countries may have a financial, educational, and social background that is not comparable to that of the country average. Subgroups are not necessarily representative of the entire population they originate from and observed differences between them should be interpreted with care.

After reviewing and critiquing the 10 selected papers, three broad themes emerged, discussed in the subsequent sections.

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Knowledge and understanding of the concept of an AED

Taniguchi et al. conducted a key study in 2006 to investigate "attitudes toward AED use in Japan".[27] They repeated this study with nearly identical methods five years later, showing a temporal developmental relationship of the studied population.[28] The 2006 study found that 15% of high-school students and 44% of teachers surveyed had knowledge of how to use AEDs. The 2011 data reported that 47% of high-school students and 89% of teachers were familiar with AEDs.

In 2013, Bogle et al.[26] conducted a similar study amongst students in an American university, although with a significantly smaller sample size. The findings indicated that 88.4% of participants could identify an AED from images, but only 18.4% could indicate the basic mechanism of an AED. One out of six (17.7%) respondents knew that the student centre had an AED but only 2% could recall its precise location within the building.

Similarly, Schober et al.[29] conducted an extensive study of 1018 bystanders at Central Railway Station in Amsterdam, which revealed a considerable lack of knowledge among the public relating to AED use. When asked what should be done as quickly as possible if someone has a suspected SCA, only 6% of participants spontaneously mentioned defibrillation or AED in any way. Strikingly, when directed towards a nearby AED, less than half (47%) were able to correctly identify the device the investigator was pointing at as a defibrillator or AED, while 53% knew the purpose of the device. When asked about who is allowed to use an AED, 34% stated that anyone is allowed to use it, 49% believed that only trained personnel may use it, and 13% believed that its use to be restricted to healthcare professionals.

In Lubin's[30] assessment of public attitudes toward AEDs, a relatively small sample size of 359 shoppers at an American mall were surveyed and 60% were able to define "defibrillator" adequately. However, the specifics of what exactly represents an adequate definition are not clearly explained by the study findings.

A German study conducted by Christ et al.[24] interviewed 531 layperson visitors to an amusement park, finding that knowledge of AED use was poor (45.2%), especially among persons younger than 17 years or older than 67. Of the interviewed visitors, 75% recognized the installed AED, while 96.2% supported the placement of an AED. Meanwhile, Cronin et al.[31] examined attitudes towards AEDs at an overall institutional level in Ireland rather than an individual level. It studied a selection of amateur sports clubs in a region in Ireland observing the prevailing attitudes that exist within the club at a management level, and the how these attitudes are reflected in the clubs approach to AED use. It also looked at AED distribution; encouragingly 81.3% of amateur clubs in the studied region owned an AED. However, this study did not investigate individual members' understanding or willingness to use an AED.

Willingness to use an AED in the event of a SCA

Concerning the willingness to use AEDs, all studies included in this review, with the exception of the Caffrey et al. paper,[16] examined participants' attitudes rather than actual behaviours. When presented with a hypothetical scenario, there are inherent possibilities that participants might answer dishonestly. As a result, the data may again overestimate knowledge and willingness to attempt to use AEDs.

The 2006 Taniguchi et al. study[27] in Japan showed that 12% of high-school students would "definitely" use an AED, while 35% of teachers gave this reply. The equivalent study in 2011 demonstrated that 73% of high-school students and 87% of teachers would "definitely" use an AED.

Meanwhile, Bogle et al.[26] found that about a quarter (28.1%) of respondents were comfortable using an

doi:10.2218/resmedica.v24i1.1470

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Journal of the Royal Medical Society
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doi:10.2218/resmedica.v24i1.1470

AED without assistance compared with 65.5% when offered assistance. However, this study did not specifically probe willingness to use in the event of SCA.

Of the 1018 bystanders surveyed by Schober et al.,[29] less than half of participants (47%) would be willing to use an AED. 43% indicated that they would not use it and 10% were unsure. Comparatively, in the study by Lubin et al.,30 71% of the shoppers surveyed stated they would be "likely" to use an AED to resuscitate a stranger.

Hubble et al.[32] conducted a cross-sectional survey exposing 683 high-school students to six different potential emergency scenarios to investigate willingness to perform cardiopulmonary resuscitation (CPR) and use an AED. Prior to the study, 86% were trained in CPR while 21% were trained in AED use.

Respondents indicated that they would be willing to perform chest compressions in 55% of cases, mouth-to-mouth resuscitation in 43% of cases, and use an AED in 32% of cases.

Lester et al.[33] conducted a cohort study in Wales to investigate the role of layperson training, whereby a sample of 1600 lay-CPR trainees was interviewed four years after training and it was found that at this time more than 80% expressed willingness to perform CPR and use an AED on a stranger in the event of a SCA.

Reasons for unwillingness to use an AED in the event of a SCA

Taniguchi et al.[27] in 2006 found that the main reasons for unwillingness to operate AEDs among both laypeople and healthcare providers were poor awareness of what an AED is or how to use it. In the 2011 study,[28] reasons for non-operation were similar to the 2006 study. 85% of respondents not willing to operate an AED cited lack of knowledge regarding the concept of AEDs and how to use them as the main reason.[28]

Bogle et al.[26] described that of those who did not feel comfortable, 87.7% indicated that they were "afraid of doing something wrong".

Lubin et al.[30] found the most common concerns were fear of using the machine incorrectly (57%) and fear of legal liability (38%). After being told of liability protection from the federal Cardiac Arrest Survival Act, 84% stated they would be likely to use the AED.

In Hubble et al.,[32] fear of injuring the patient (31.2%) and fear of legal consequences (16.9%) were the most common reasons for unwillingness to use an AED. Based on the findings of the papers included in this review, it appears that the primary reasons for public reluctance to use AEDs are:

- Poor awareness of AED purpose
- Poor knowledge of AED operation
- Fear of incorrect usage
- Fear of injuring the patient
- Fear of legal liability.

Understanding the reasons for public unwillingness to use AEDs can help to inform future initiatives to address these issues.

DISCUSSION

The results of this review make for an interesting comparison of layperson understanding of AED use in different contexts and settings, and among different population demographics. Considering the frequency and significance of SCA to public health, this is an important topic of discussion in community medicine.

We sought to compare the documented knowledge levels in different communities and population subsets. This review compared the responses of participants from diverse backgrounds ranging from bystanders at train stations and airports, high-school and university students, to visitors at an amusement park and customers in a shopping centre. Laypersons were the focus of investigation in all studies, although some studies did also include participants with medical

doi:10.2218/resmedica.v24i1.1470

backgrounds. Four of the reviewed papers identified random members of the public at particular locations (e.g. a train station) as the study population, while six of the papers studied selected predetermined cohorts of a population (e.g. university students).

There are significant differences evident between the studied populations in that they originate from vastly contrasting social and cultural backgrounds and display very different age profiles. However, a common thread that is immediately apparent throughout the reviewed papers is that the baseline understanding of the role and use of an AED among laypersons is largely inadequate. This suggests that the potential public health benefit of increased AED placement is not being maximized at present. This is reflected to a large extent in national out-of-hospital cardiac arrest survival rates,[3] which also show considerable scope for improvement.

The lack of knowledge among members of the public regarding AED use was a key finding of this review. This was particularly evident in the studies of Schober et al., [29] Bogle et al.,[26] Christ et al.,[24] and Taniguchi et al.[27] Schober et al.[29] found that only a minority of individuals had sufficient knowledge and would be willing to use an AED. Only 61 of the 1018 train passengers surveyed spontaneously indicated that they would consider AED use when confronted with a SCA. This indicates a lack of awareness and familiarity with the important role and purpose of the AED. It was thus perhaps unsurprising that when prompted about the role of the AED, less than half of participants said they would be willing to attempt to use it.

In addition to this lack of understanding regarding the functioning of AEDs, there is concerning evidence to suggest that there are inadequate levels of awareness of AED location and access among members of the public. This is perhaps most apparent in the study by Bogle et al.,[26] which sought to quantify knowledge and attitudes regarding AEDs and resuscitation among students in an American university in 2013. This study found that of the 237 students surveyed, 42 knew that their student centre had an AED, while only four could recall its precise location. This is an educated subset of society, yet on a campus with 37 AEDs, almost all students were unable to recall the precise location of one. This alarming figure highlights an important issue. While there have been considerable developments in the technology and distribution of AEDs in recent years, these efforts may prove somewhat futile if the devices cannot be located and used in a timely manner when required. AEDs cannot exert their maximal public health benefits unless the awareness and attitudes of the associated populations towards this life-saving device is of a satisfactory level. Students displayed a very limited knowledge of AED purpose, yet are undoubtedly active members of their respective communities and very receptive to learning. There is considerable opportunity for improvement in this area with appropriate educational initiatives. Although the Christ et al. study[24] was a similarly small-scale survey with a sample size of 531, the researchers came to the interesting conclusion that the placement of AEDs in public places in combination with intensive medical education can result in a high AED acceptance and recognition. This concept needs to be investigated on a grander scale.

This lack of understanding is further reflected in the levels of confidence and willingness to use AEDs in appropriate scenarios, which emerged as another key theme throughout this review. Taniguchi et al.[27] showed that a similarly large proportion of the Japanese lay-population lacked knowledge of how to use an AED, and subsequently would be unwilling to operate the device in the event of SCA as a result. However, many non-medical people in Japan stated that they would be willing to operate AEDs if they had better understanding of the equipment and its operation.

This suggests that it is necessary to provide better education to non-medical people regarding what an

doi:10.2218/resmedica.v24i1.1470

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AED is and how to use it. The paired studies conducted by Taniguchi et al.[27,28] in Japan are the only papers that offer an assessment of the development of knowledge and understanding in the same study population over a given time period. The findings of these studies reported a significant increase in knowledge and willingness to use AEDs among laypersons from the year 2006 to 2011. While there was no definitive causative factor for this increase, it was suggested that a heightened general public awareness of the AED concept might be associated with an increase in population willingness to use an AED in the event of a SCA.

Publicly accessible AEDs are a relatively new phenomenon and, as technology has improved, the distribution of these devices has become more widespread. This could have been an important factor in the increasingly positive public attitudes reported by the temporal trends in the Taniguchi studies. However, more research needs to be conducted in this particular area to document increasing AED use and improving public attitudes in areas where this relatively new technology has become more freely available. The results suggest the potential importance of raising the awareness of individuals with non-medical backgrounds to the concept of AEDs and the need to learn how to use them.

The third key theme identified throughout this review was the reason for unwillingness to use an AED. Despite the contrasts in the populations being reviewed, a number of common reasons for reluctance were apparent across the various papers. The primary issues identified among the laypersons studied centred around fear and lack of understanding. This manifested itself in the forms of poor awareness of AED purpose, poor knowledge of AED operation, fear of incorrect usage, fear of injuring the patient, and fear of legal liability. In the Taniguchi 2011 study,[28] 85% of respondents not willing to operate an AED cited lack of knowledge regarding the concept of AEDs and how to use them as the main reason.

Following on from this, the Lubin et al. study[30] found that although a substantial number of surveyed shoppers were willing to use an AED, education regarding legal liability and proper use of the machines increased the reported likelihood of use. Similar associations between training and willingness to attempt AED use are reported in the studies of Lester et al.[33] and Hubble et al.[32] Understanding the reasons for public unwillingness to use AEDs can help to identify future research directions and inform future initiatives and investment to address these issues of fear and inadequate understanding. Further public education is necessary to provide optimally effective public access defibrillation programs.

A number of important issues have been highlighted in this review. The low levels of understanding of AEDs among members of the general public is concerning. At present there is no definitive evidence to suggest whether or not a community educational programme could have a long-term impact on layperson knowledge of AED use, or how such a programme could affect general public attitudes in relation to SCA response.

Strengths of this review: This review was conducted in a systematic manner. All literature included was selected using a transparent, repeatable selection process, and analysed in an unbiased way using an established critical appraisal framework.[25] A number of different databases were searched and every effort was made to include all relevant studies.

Limitations of this review: This review includes inevitable limitations as only papers with full free text availability were considered for inclusion, which may have led to exclusion of relevant papers. The three-step selection process for screening the searched papers, as described in the methods, was conducted by one person only, namely the first author of this paper, and subsequently reviewed by the last author. This screening strategy created potential for misinterpretation and bias of the literature, thus

doi:10.2218/resmedica.v24i1.1470

influencing the results. This could be reduced in the future by addition of further secondary reviewers. Furthermore, the inclusion of non-laypersons in certain studies was a potential source of bias in the identification of themes.

Future Research: Further research is needed to fully assess existing public knowledge and attitudes towards AED among broader population subsections in order to improve the external validity of this research. Recent randomized controlled trials have investigated the effect of video lessons in training laypersons the skills of CPR.[34–36] These studies suggest the potential role that an educational programme might have in improving knowledge levels. Further research should be conducted to investigate the impact of education on layperson understanding and willingness to use an AED.

CONCLUSION

There is a paucity of literature relating to layperson understanding of AED function and use. Similarly, the topic of layperson attitudes towards AED use is under-studied. The overall baseline knowledge and understanding of the role and use of an AED among the studied populations of laypersons was relatively poor. The evidence suggests only a minority of laypersons would be confident or willing to use an AED in the event of a nearby SCA.

The extent to which an educational intervention could impact upon layperson understanding and confidence in the use of an AED is poorly understood at present. Currently, there is insufficient data to suggest whether or not a community educational programme could have a long-term impact on improving laypersons' attitudes towards AED use. Further research must be conducted into understanding and improving the attitudes of laypeople towards AEDs in order to maximize their public health benefit, with the ultimate long-term outcome of improving survival rates of out-of-hospital cardiac arrest.

Competing Interest and Funding

Nothing to declare

REFERENCES

1. Mann DL, Zipes DP, Libby P, Bonow RO. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Philadelphia, PA, USA: Elsevier Health Sciences; 2014.

2. Taniguchi D, Baernstein A, Nichol G. Cardiac arrest: a public health perspective. Emerg Med Clin NorthAm.2012;30(1):1–12.DOI: 10.1016/j.emc.2011.09.003.

3. Berdowski J, Berg RA, Tijssen JG, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: Systematic review of 67 prospective studies. Resuscitation. 2010;81(11):1479–87. DOI: 10.1016/j.resuscitation.2010.08.006.

4. Perkins GD, Cooke MW. Variability in cardiac arrest survival: the NHS Ambulance Service Quality Indicators. Emerg Med J. 2012;29(1):3–5. DOI: 10.1136/emermed-2011-200758.

5. Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, et al. Regional variation in out-of-hospital cardiac arrest incidence and outcome. JAMA. 2008;300(12):1423–31. DOI: 10.1001/jama.300.12.1423.

6. Ambulance Service Association. National Cardiac Arrest Audit Report. London, UK: Ambulance Service Association; 2006.

7. NHS England. Ambulance Quality Indicators Data 2013-14. NHS England website. 2014. https://www.england.nhs.uk/statistics/statistical-work-areas/ambulance-quality-indicators/ambulance-quality-indicators-data-2013-14/ (accessed 15 April 2017).

8. National Out-of-Hospital Cardiac Arrest Register. Sixth Annual Report. 2014. http://www.phecit.ie/Images/PHECC/Publications%20and%20Media/Other%20Publications/5.1%20OHCAR

%206th%20Annual%20Report.pdf (accessed 15 April 2017).

9. Lindner TW, Søreide E, Nilsen OB, Torunn MW, Lossius HM. Good outcome in every fourth resuscitation attempt is achievable – an Utstein template report from the Stavanger region. Resuscitation. 2011;82(12):1508–13. DOI: 10.1016/j.resuscitation.2011.06.016.

10. Division of Emergency Medical Services. 2013 Annual Report to the King County Council. Public Health – Seattle & King County. 2013. http://www.kingcounty.gov/depts/health/emergency-medical-services/%7e/media/depts/health/emergency-medical-services/documents/reports/2013AnnualReport.ashx (accessed 15 April 2017).

11. Gräsner JT, Herlitz J, Koster RW, Rosell-Ortiz F, Stamatakis L, Bossaert L. Quality management in resuscitation – towards a European cardiac arrest registry (EuReCa). Resuscitation. 2011;82(8):989–94. DOI: 10.1016/j.resuscitation.2011.02.047.

12. Cummins RO, Ornato JP, Thies WH, Pepe PE. Improving survival from sudden cardiac arrest: the "chain of survival" concept. Circulation. 1991;83(5):1832–47.

13. Field JM, Hazinski MF, Sayre MR, Chameides L, Schexnayder SM, Hemphill R, et al. Part 1: executive summary: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122(18 Suppl 3):S640–56. DOI: 10.1161/CIRCULATIONAHA.110.970889.

14. The American Heart Association. Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 4: the automated external defibrillator: key link in the chain of survival. Circulation. 2000;102(8 Suppl):I60–76. DOI: 10.1161/01.CIR.102.suppl_1.I-60.

15. Capucci A, Aschieri D, Piepoli MF, Bardy GH, Iconomu E, Arvedi M. Tripling survival from sudden cardiac arrest via early defibrillation without traditional education in cardiopulmonary resuscitation. Circulation. 2002;106(9):1065–70. DOI: 10.1161/01.CIR.0000028148.62305.69.

16. Caffrey SL, Willoughby PJ, Pepe PE, Becker LB. Public use of automated external defibrillators. N Engl J Med. 2002;347(16):1242–7. DOI: 10.1056/NEJMoa020932.

17. Murakami Y, Iwami T, Kitamura T, Nishiyama C, Nishiuchi T, Hayashi Y, et al. Outcomes of out-of-hospital cardiac arrest by public location in the public-access defibrillation era. J Am Heart Assoc. 2014;3(2):e000533. DOI: 10.1161/JAHA.113.000533.

18. Larsen MP, Eisenberg MS, Cummins RO, Hallstrom AP. Predicting survival from out-of-hospital cardiac arrest: a graphic model. Ann Emerg Med. 1993;22(11):1652-8.

19. Margey R, Browne L, Murphy E, Barrett C, Doyle B, Galvin J, et al. Survival to hospital discharge after out of hospital cardiac arrest – the importance of automated external defibrillator availability. Irish Cardiac Society. 2007;7. http://archive.newsweaver.com/cardiacsociety/newsweaver.ie/cardiacsociety/e_article00094160264e4.html?x=b11,0,w.

20. Colquhoun MC, Chamberlain DA, Newcombe RG, Harris R, Harris S, Peel K, et al. A national scheme for public access defibrillation in England and Wales: early results. Resuscitation. 2008;78(3):275–80. DOI: 10.1016/j.resuscitation.2008.03.226.

21. Maron BJ, Haas TS, Doerer JJ, Thompson PD, Hodges JS. Comparison of U.S. and Italian experiences with sudden cardiac deaths in young competitive athletes and implications for preparticipation screening strategies. Am J Cardiol. 2009 15;104(2):276–80. DOI: 10.1016/j.amjcard.2009.03.037.

22. Koester MC. A review of sudden cardiac death in young athletes and strategies for preparticipation

cardiovascular screening. J Athl Train. 2001;36(2):197–204.

23. Corrado D, Drezner J, Basso C, Pelliccia A, Thiene G. Strategies for the prevention of sudden cardiac death during sports. Eur J Cardiovasc Prev Rehabil. 2011;18(2):197–208.

DOI: 10.1177/1741826710389924.

24. Christ M, van Bracht M, Prull MW, Trappe HJ. [Influences of medical education on first aid and AED knowledge among laypersons] [German]. Dtsch Med Wochenschr. 2012;137(44):2251–5. DOI: 10.1055/s-0032-1305282.

25. Glynn L. EBLIP Critical Appraisal Checklist. Memorial University of Newfoundland. 2006. http://ebltoolkit.pbworks.com/f/EBLCriticalAppraisalChecklist.pdf (accessed 15 April 2017).

26. Bogle B, Mehrotra S, Chiampas G, Aldeen AZ. Assessment of knowledge and attitudes regarding automated external defibrillators and cardiopulmonary resuscitation among American University students. Emerg Med J. 2013;30(10):837–41. DOI: 10.1136/emermed-2012-201555.

27. Taniguchi T, Omi W, Inaba H. Attitudes toward automated external defibrillator use in Japan. Resuscitation. 2008;79(2):288–91. DOI: 10.1016/j.resuscitation.2008.05.011.

28. Taniguchi T, Sato K, Kurita A, Noda T, Okajima M. Attitudes toward automated external defibrillator use in Japan in 2011. J Anesth. 2014;28(1):34–7. DOI: 10.1007/s00540-013-1662-0.

29. Schober P, van Dehn FB, Bierens JJ, Loer SA, Schwarte LA. Public access defibrillation: time to access the public. Ann Emerg Med. 2011;58(3):240–7. DOI: 10.1016/j.annemergmed.2010.12.016.

30. Lubin J, Chung SS, Williams K. An assessment of public attitudes toward automated external defibrillators. Resuscitation. 2004;62(1):43–7. DOI: 10.1016/j.resuscitation.2004.02.006.

31. Cronin O, Jordan J, Quigley F, Molloy MG. Prepared for sudden cardiac arrest? A cross-sectional study of automated external defibrillators in amateur sport. Br J Sports Med. 2013;47(18):1171–4. DOI: 10.1136/bjsports-2013-092919.

32. Hubble MW, Bachman M, Price R, Martin N, Huie D. Willingness of high school students to perform cardiopulmonary resuscitation and automated external defibrillation. Prehosp Emerg Care. 2003;7(2):219–24. DOI: 10.1080/10903120390936815.

33. Lester CA, Donnelly PD, Assar D. Lay CPR trainees: retraining, confidence and willingness to attempt resuscitation 4 years after training. Resuscitation. 2000;45(2):77–82. DOI: 10.1016/S0300-9572(00)00170-2.

34. Bobrow BJ, Vadeboncoeur TF, Spaite DW, Potts J, Denninghoff K, Chikani V, et al. The effectiveness of ultrabrief and brief educational videos for training lay responders in hands-only cardiopulmonary resuscitation: implications for the future of citizen cardiopulmonary resuscitation training. Circ Cardiovasc Qual Outcomes. 2011;4(2):220–6. DOI: 10.1161/CIRCOUTCOMES.110.959353.

35. Kelley J, Richman PB, Ewy GA, Clark L, Bulloch B, Bobrow BJ. Eighth grade students become proficient at CPR and use of an AED following a condensed training programme. Resuscitation. 2006;71(2):229–36. DOI: 10.1016/j.resuscitation.2006.03.015.

36. Lynch B, Einspruch EL, Nichol G, Becker LB, Aufderheide TP, Idris A. Effectiveness of a 30-min CPR self-instruction program for lay responders: a controlled randomized study. Resuscitation. 2005;67(1):31–43. DOI: 10.1016/j.resuscitation.20